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White Grub 'Kurmula' *Holotrichia spp.* an Agriculture Important Pest in India: A Review

M.P. Gautam[1], R.K. Doharey[2], Shesh Narain Singh[3]

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ABSTRACT

White grubs are the distractive, public Importance and a genuine requirement to *Kharif* crops become under rainfed conditions. Both the grubs and grown-ups are polyphagous and univoltine. No single control measure is powerful for their administration consequently is the lone alternative for their compelling administration in the sloping zone. Therefore, the stock of the insects joins 24 species having a place with 13 genera under 5 subfamilies. White grubs are larvae of melolonthinae (Scarabaeidae : Coleoptera) but the term includes larvae of Rutelinae, Dynastinae, Cetoniinae and other families of Scarabaeidea superfamily. The use of the compound bug spray on the banks of the stream makes the water contamination the following towns and makes the odds of obstruction improvement in bother. White grub damage typically appears as stunted, wilted, discolored, or dead seedlings and/or as gaps in rows where plants fail to emerge. White grubs prune roots and can feed on the mesocotyl causing plant death.

Key words: Diversity, *Holotrichia* spp., Management, White grub.

White grub creepy crawlies are called 'May-June scarabs' or 'Chafer bugs' or 'Leaf Chafer'. They have a place with the request Coleoptera and the family Scarabaeidae. White grub is a hatchling of Melolonthidae. The Scarabaeidae is the most significant group of request Coleoptera. Family Scarabaeidae is again partitioned into subfamilies- Scarabaeinae, Cetoniinae, Dynastinae, Rutelinae, Melolonthinae, Troginae, Hyposorinae, Aphodiinae. White grubs are otherwise called hatchlings of lamellicorn insects, different sorts of hatchlings or grubs in terms of morphology, event, species dispersion, scientific categorization and so on are seen in the various agro-biological system. In which, ordinarily accessible are the Masked Chafers, *Cyclocephala* spp; May-June bug, *Phylophaga* spp. and Japanese scarab, *Popillia japonica*.

Systematic position of Scarabaeidae-

Phylum- Chordate
Order- Coleoptera
Family- Scarabaeidae

In India, expanding populace, ranchers have utilized the land with high worth money business yields like potato, sugarcane, maize, groundnut into their farmland. The business developing taproot crops in which the Scarabs have become progressively enter and produce genuine agrarian bugs. The *Holotrichia serrata* (Fab.), *Holotrichia consaguinea* (Bl.), *Holotrichia fissa* (Bre.), *Holotrichia insularis* (Bre), *Lepidopholis Lepidoptera* (Bl.), *Anomola bengalensis*, *Oryctes rhinoceros* (L.), *Phyllognathus dinoysicus* (F) are affordable significant irritation of white grubs. The types of Holotrichia are very much disseminated in India. Accordingly and discovered to be extremely dangerous. In our nation 'white grub' is a significant issue because of which they have been distinguished as National vermin. As of late white grubs have accepted a genuine nuisance issue to a few yields. *Holotrichia serrata* (Fab) is one of the noticeable types of grub in Maharashtra (Raodeo and Deshpande, 1974), likewise found in Mysore, Uttar Pradesh and Tamil Nadu.

[1]Faculty of Agriculture, Asha Bhagwan Bux Singh Mahavidyalaya, Ayodhya-224 135, Uttar Pradesh, India.
[2]Department of Extension Education, College of Agriculture, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya-224 229, Uttar Pradesh, India.
[3]SMS (Plant Protection), Krishi Vigyan Kendra, Ladaura, Azamgarh-II, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya-224 229, Uttar Pradesh, India.

Corresponding Author: Shesh Narain Singh, SMS (Plant Protection), Krishi Vigyan Kendra, Ladaura, Azamgarh-II, Acharya Narendra Deva University of Agriculture and Technology, Ayodhya-224 229, Uttar Pradesh, India. Email: shesh.narain.singh@gmail.com

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Species dispersion

In Coleoptera, the Scarabaeoidea is perhaps the biggest superfamily and involves roughly 31,000 species worldwide of which the family Scarabaeidae is made out of about 91% of all the scarabaeoid and incorporates around 27,800 species around the world (Fincher, 1989; Jameson *et al.,* 2001). Most extreme numbers happen in the tropical spaces of the world, especially in the African and Oriental locales. The family Scarabaeidae addresses around 2,500 species from the Indian sub-mainland to which most of the phytophagous scarabs have a place with and the financially most significant

subfamilies incorporate Melolonthinae, Rutelinae, Dynastinae and Cetoniinae (Kumar *et al.,* 2019). White grubs are not kidding polyphagous bother harming principally sugarcane crop situated along the banks of Kumbhi Kasari stream. Plus, *Holotrichia serrata, Holotrichia fissa, Holotrichia karschi*and *Phyllognathus dionysius* likewise accomplished the irritation status in fields of paddy, jowar, maize, turmeric and tobacco. White grubs (Coleoptera: Scarabaeidae) are the dirt hindering and root taking care of juvenile phases of scarab insects of which larval stage is ruinous (Theurkar, 2013). The white grub's family is the second-biggest family which incorporates more than 30,000 species (Khanal *et al.* 2012). Close around 300 types of white grub were recorded from India (Bhawane *et al.* 2011). White grubs are expansive, plump, whitish or grayish-white and the body is bent as 'C' shape. The vast majority of the white grubs particularly from the sub-family Melolonthinae are generally damaging and irksome soil creepy crawlies in numerous parts to specific endemics pockets in the territories of Rajasthan, Uttar Pradesh, Gujarat, Maharashtra and Karnataka (Bhawane *et al.* 2012). Kumar *et al.,* (2017) uncovered 12 significant types of Scarabaeidae. Of these, six species had a place with Melolonthinae *viz.*, *Holotrichia reynaudi* (Blanchard), *Holotrichia fissa* (Brenske), *Holotrichia serrata* (Fabricius), *Holotrichia consanguinea* (Blanchard), *Schizonycha ruficollis* (Fabricius), *Maladera insanabilis* (Brenske), five species to Rutelinae *viz.*, *Anomala dorsalis* (Fabricius), *Anomala bengalensis* (Blanchard), *Adoretus testaceus* (Hope), *Adoretus lasiopygus* (Burmester), *Adoretus versutus* Harold and one animal groups to Dynastinae *viz*., *Phyllognathus dionysius* (Fabricius) that were overwhelming. *Adoretus testaceus* was recorded interestingly from Rajasthan. Theurkar, *et al.,* (2012) recorded five significant types of white grubs particularly in Maharashtra specifically *Holotrachiafissa* Br., *Anomola sp.* (Rutelidae) *Holotrachia serrata* Fab., *Holotrachia consaguinea* Bl., *Leucopholis Lepidoptera* Bl. (Melolonthidae), in conveyance. In the current assessment, Scarabaeidae adults were assembled from leaves of host plants like Neem, Babhul, Ber and Khair. The *Holotrachia serrata* is the most abundant species found in Khed Taluka which is fundamental for Northern Western Ghats (MS), India.

Diversity

Bhawane *et al.,* (2012) noticed the variety of white grub scarabs and their eating regimen expansiveness from the Kolhapur region, Maharashtra. The eating regimen broadness of these species was evaluated in both developed fields and regular stands. A sum of 29 species categories was recorded during the investigation time frame under 22 genera dispersed in 4 subfamilies of the family Scarabaeidae. Grubs of *Leucopholis lepidophora*, *Holotrichia fissa*, *Holotrichia karschi, Holotrichia serrata, Adoretus versutus, Adoretus lasiopygus, Anomala bengalensis* are polyphagous root grubs and genuine nuisances of rural, green and silvicultural crops. One type of Dynastinae, Oryctes rhinoceros and eight types of Cetoniinae are notable foragers primarily occupied with the deterioration of plant material however their grown-up structures feed on the flower parts without perceptible harm doubtlessly helping in the cross-fertilization of the host plants. Murthy, (2020) observed that the species distribution was assessed and 18 species of scarabaeid beetles were recorded from the diversified cropping pattern comprising of areca nut, coconut, groundnut, millets, mulberry, pepper, sugarcane, tapioca and vegetables) was explored. The leaf feeders, Melolonthid beetles (38.23%) was more abundant in the states followed by the Rutelinids (20.53%). The cropping pattern, geographical location and the soil type determined the occurrence of the different species in the states.

Biology of white grub

White grubs are the juvenile types of scarab creepy crawlies, the notable May/June bugs, covered chafer and Japanese bugs. The grubs, 1/4 to more than 1 inch (6-25 mm) long, are white with earthy colored heads and have six conspicuous legs. Their bodies ordinarily are bent into a "C" shape. The grown-up scarabs rise out of pupae in October and sleep in soil work next season. With the main storm rains in June (following year), the grown-ups arise out during sunset from the dirt, fly short and feed on the foliage of trees like Neem, Ber, Acacia and so on In the next morning grown-ups return to the soil, cover-up and lay eggs. Females lay around 30 eggs in soil over a time of 3 weeks. The hatching period is 10 days. The grub stage goes on for 70 days. These species have one age each year.

Larvae

The 'C' shape larval legs are all around growing yet seldom utilized for velocity. Head is huge or slanted earthy colored in shading with dim hint downwardly slanted firmly sclerotized, with amazing uncovered mandibles (Imms, 1957). The harm brought about by Scarab hatchlings is assessed to lessen the harvest yields by around 40-80 per cent (Prasad and Thakur, 1959; Raodeo, 1974) and in a later report by around 12-60 per cent (Pokhrel, 2004). The white grub, *Holotrichia species* hatchlings are fed on the tap underlying foundations of the seedlings and the harmed plants wither and pass on (Bandara, 1990). In Uttar Pradesh, India during May-September 1991 showed that eggs and first instar hatchlings were found during June-July, with second and third instar hatchlings harming potato tubers toward the finish of July and mid-August individually (Mishra and Singh, 1991). The recently arisen grub of *Holotrichia species* is velvety white in shading. They are three instars of the vermin and body length and body width change with the species. The first and second instar hatchlings period is short in contrast with the third instars hatchlings (Singh and Mishra, 2003).

Adult

The grown-up creepy crawlies rise out of pupae in October and rest in soil work next season. With the primary storm

rains in June(following year), the grown-ups arise out during sunset from the dirt, fly short and feed on the foliage of trees like Neem, Ber, Acacia and so on In the next morning grown-ups return to the soil, cover-up and lay eggs. Females lay around 30 eggs in soil over a time of 3 weeks. The hatching period is 10 days. The grub stage goes on for 70 days. These species have one age each year. The rises of scarabs happened at the hour of nightfall at 27-30°C. In certain species, guys and females can be recognized by contrast in the width of the portions of the lower surface of the mid-region (Crocker *et al.,* 1995). The scarab bugs benefiting from having plants may initiate the creation of poisons and edibility diminishes (Dicke, 1999). Ruler (1984) saw that the grown-ups of numerous monetarily significant species are the same by all accounts and can be related to certainty exclusively by reference to the male genitalia; these are shown. There is likewise a shown key to the last instar hatchlings dependent on the plans of setal hairs (rasters) on the venters of their terminal stomach portions. The white grub grown-up rise time, they need some downpour at any rate 11 mm on the most recent seven-day stretch of May. Precipitation, temperature, climatic stickiness and wind speed to great extent forests the rise, development and circulation of grown-ups (Mishra and Singh, 1999). The second fortnight of June was noticed as the pinnacle time of June bugs and development proceeded until the fortnight of August (Mittal, 2000). As this pre-rainstorm mugginess increments the storm's appearance, it might likewise give a similar trigger to the board activity through grown-up control of 3 *Holotrichia species* is being endeavored in the groundnut region (Raju *et al.,* 2005; Yadava and Sharma, 1995; Anith *et al.,* 2006).

Pest damage

Grubs have a long history as vermin of ranch yields and woodland trees and have caused broad harm in pine nurseries, causing misfortunes of 25-40% (Johnston and Eaton, 1939). The grubs feed on underlying foundations of practically every one of the harvests, similar to the Potato, Maize, Wheat, Grain, Jawar, Bajara, Groundnut, Sesame, Sunflower, Chilies, Cotton, Sugarcane, Tobacco, Brinjal, Cucurbit and woman's figure including turf, glades, yards and timberland trees (Oya, 1995; Fujiie and Yakoyama, 1996; Arita *et al.,* 1993; Potter *et al.,* 1992). The 100% harm to yields of the pervasion was brought about by white grub (Yadava and Vijayvergia (1994). The Scarabaeids harm groundnut and on the planet, posting a complete 22 animal varieties from 9 genera related to groundnut in India (Wightman and Rangarao, 1994). White grub harming groundnut in the area incorporates (Hussain, 1974; Rao *et al.,* 1976; Pal, 1977).

Diagnostic characteristics

Damage to plant

- Fed-upon roots or root misfortune.
- Abnormal plant stature.
- Color of the plant.
- Orange-yellow leaves wilting.

Signs

- Ovoid and velvety white eggs.
- Adults benefiting from the leaves.
- Grubs or hatchlings benefiting from the roots.

Elements preferring bug bother improvement

- Plants with a sinewy root framework.
- Soil dampness prerequisites.
- Upland and rainfed wetland rice conditions.

Symptoms

- Orange-yellow leaves.
- Wilting plants.
- Stunted plants.
- Root misfortune.

Host preference

The inclination of grown-ups *Holotrichia species* for mating and taking care of trees are known for certain species in different pieces of India, grown-up have trees incorporate ber (*Zizyphus spp.*), drumstick (*Moringa oleifera*), Neem (*Azadirachta indica*) and (Yadava and Sharma, 1995) with a 1:1 sex proportion for grown-ups on trees (Leal *et al.,* 1996). *Holotrichia serrata* happens most regularly on babul, *Acacia spp*. and Neem, *Butea monosperma* (Yadava and Sharma, 1995). The grown-up of *Holotrichia serrata* grown-ups benefits from the foliage of host trees like neem, *Ailanthus sp*., *Ziziphus sp*., (*Acacia arabica*), *Prosopis sp*. and so forth (Nair, 2011). The white grub species, *Anomala dimidiate* in Kumaon Hills announced 32 food species from food yields and 18 host plants during larval stages (Verma, 1993). The types of cetoniinae superfamily show a diurnal propensity to feed on blossoms just like plant sap and organic products (Mico *et al.,* 2008).

Management

Overpopulation, substance industrialization, rural pesticides have contributed different approaches to the natural weakening or ecological contamination. Contamination is an unwanted change in nature, substance and physiological qualities of our general climate that has been hurtful to the human existence and living organic entities. India is a rural country. After green unrest, the greater part of ranchers is utilized the compound bug sprays to control the agrarian vermin. This pesticide is a gathering of synthetic compounds that are ordered based on the utilization and creature murdered. Pesticides as any substances or combination of substances planned for forestalling, repulsing, or alleviating, annihilating any bug characterized by the U.S. Ecological Protection Agency (Ecobichon, 2001). The significant agrarian pesticides classes that bug sprays, herbicides and fungicides, bother control specialists are assembled as acaricides, larvicides, miticides, molluscicides, rodenticides and scabicides. Agrarian pesticide application has additionally expected reason for the decrease in creatures of land and water however a couple of studies have

straightforwardly connected pesticide application to land and water proficient decay (Richards and Kendall, 2002).

Cultural management

The social acts of pre-summer and late-summer furrowing or disking give control in regions where predaceous birds happen (*e.g.*, the Atlantic Coastal Plain). Harvest pivot, be that as it may, is the best social control strategy. Because of its long larval turn of events, crop pivot doesn't give satisfactory control of white grubs. Spring culturing may diminish white grub populaces by slaughtering white grubs close to the surface whenever plowed after grubs get back to the root zone. Moldboard furrowing turns over soil presenting grubs to birds. Profound established vegetables, similar to hay and clovers are phenomenal yields with which to pivot corn or little grains, particularly following long stretches of bizarrely substantial May creepy-crawly flights.

Organic management

The substance insect poisons have not a compelling consequence of the white grub the executive's framework and these synthetic pesticides have unsafe impacts happen on the individual and different living beings. The Datura, *Datura innoxia* and Bitti, *Thevetia peruviana* (Pers) plant extractives were utilized for exploratory investigation. Both Biopesticides show variety in toxicological, substance properties and display diverse organic effects. Ayub *et al.,* (2019) showed that the most extreme repellency (98.30%) was seen at 5% concentrate in Ethanol following 3 hours of openness. The greatest mortality (97.00%) in white grub was recorded at 5% concentrate in $(CH_3)_2CO$ after 72 Hr of bug openness. The outcomes uncovered that *A. sieversiana* Ehrh. Has double properties repellency and leftover poisonousness and can be utilized for eco-accommodating administration of white grub supplanting substance insect poisons.

Microbial control

Among the microbial control specialists entomogenous growths like *Beauveria basssiana* (Balsama) Vuillemin and *Beauveria brongniarti* (Matschinikoff) Sorokin have 14 demonstrated amazing control against an enormous number of creepy-crawly bothers (Pandey and Kanaujia, 2005); microbial investigations of the gut of *Holotrichia serrata* (fab) (Patil and Bhawane, 1997).

Mechanical control

The light soil gives the ideal condition for the endurance and increase of the numerous irritations (Blossey and Joshi, 2003). In Nepal, such soil has been brought under development with better water system offices, the grub continuously duplicated and turn into the genuine danger to crops nearby, a comparable circumstance is additionally detailed in India (Singh and Mishra, 2003). The dethatching in the mid-year before when you would treat for white grub will be useful. On the off chance that the water system is accessible, apply 0.5 inches of water 28.48 hours preceding treatment to bring bugs up towards the surface and to wet the cover.

Biopesticidal control

Adequacy of plants *viz.* neem, *Azadirachta indica* (L.), *Chrysanthemum cinerariafolium* (L.), *Vetex negundo* (L.) *Sapindus mukorossi* (L.), task, *Jatropha curcas* (L.), *Utricadiocia* (L.) and bitti, *Nerium oleander* (L.), separated in native cow (Hariana) pee and utilized @ 5 ml/liter was tried in the field preliminaries during 2007 and 2008 to control with grub, *Brahminacoriacae* (Hope) (Puja Rani *et al.,* 2009). Kumbhar *et al.* (2019) recorded that the treatment with M. anisopliae-powder base @ 5 gm for every liter was discovered to be essentially better over untreated control and recorded 9.36 per cent clusters mortality at 60 DAT. Treatment with Entomopathogenic Nematode-Powder @ 5 gm for every liter showed 11.68 per cent bunches mortality at 60 DAT were next arranged by adequacy.

Bio-rational control

The bio-levelheaded control measures are as of late created and received to control the white grubs. Bio-sane controls utilized in the mix may grant synergistic mortality on grub populaces. This may happen if the two specialists assault diverse sub-populaces (*i.e.*, grubs taking care of at various profundities) or on the off chance that one specialist (for example sub-lethal portion of legitimacy) inclines a bug to another specialist.

Chemical control

Little neem trees might be splashed with carbaryl or endosulfan or cloropyriphos following the primary summer showers to execute congregating scarabs (Nair, 2011). Albeit, the large parts of the neem trees might be showered with the cloropyriphos and decreased the scarab defoliation. Patel *et al.,* (2020) The dirt dousing of Imidacloprid 40% + Fipronil 40% - 80% WG @ 250 g for each ha and Clothianidin half WDG @ 250 gm for every ha was the protected and best medicines against white grub in groundnut followed by Chlorpyriphos 20% EC @ 4000 ml for each ha. Even though, dirt soaking of Imidacloprid 40% + Fipronil 40%-80 WG @ 250 g for every ha was the most beneficial treatment (NICBR = 1:2.38), nonetheless, Imidacloprid 40% + Fipronil 40%-80 WG @ 250 g for each ha demonstrated as the best treatment against white grub in groundnut crop. Jakhar, *et al.,* (2020) Imidacloprid 600 FS @ 6.5 ml per kg seed treatment was altogether better over any remaining medicines with least plant mortality against white grub and most elevated case yield followed by clothianidin 50 WDG @ 2.0 g per kg seed. Patel *et al.,* (2020) Treatment mix of S1P1F2 (S1: imidacloprid 40% + fipronil 40%-80 WG @ 50 g for each ha, F2: urea 50 kg/ha, P1: Chlorpyriphos 20% EC @ 4 lit/ha) most extreme decrease of plant mortality than the S0, P0 and F0 (S0: No Seed treatment, P0: No pesticide application, F0: No utilization of urea) and grub populace with high return can be taken.

CONCLUSION

The white grub or 'Kurmula' as it is generally known in the Kumaun area is the most ruinous irritation of the agro-plant crops. The grubs are underground and feed effectively on the living roots, while the creepy crawlies assemble on many host trees and plants and burn through their leaves, blossoms and at times, even the youthful organic products, consequently causing monetary misfortune. In the current investigation, an endeavor has been made to evaluate species variety of the scarab creepy crawlies in a couple of various regions of area Almora. So usage of different definitions of biopesticides can build the proficiency of control by a decrease of the measure of applied bug sprays, limiting bug opposition and ecological defilement dangers. There are no references found in regards to the bioefficacy of different formulations of EPNs, EPFs. So this discovering will be valuable for different laborers for additional examinations.

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Conflict of interest

The authors decelerated that there is no irreconcilable situation among them.

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